

## Radiological finding in pediatric patients with urinary tract infections

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### Summary:

**Background;** determining what radiologic studies to obtain following the diagnosis of a urinary tract infection(uti) is an area of medicine that is still not agreed upon, nor is there a gold standard.

**Objective;** to study the radiological abnormalities in paediatric patients with urinary tract infections.

**Patients and methods;** this prospective study was done from the first of June 2008 to the first of May 2009 include 104 pediatric patients who were referred to children welfare hospital ,(pediatric nephrological out patient clinic) with signs and symptoms of urinary tract infections, all of them had culture positive urine examination , ultrasonography was done for all patients, voiding cystourethrography was done for patients with recurrent attacks of urinary tracts infections (58 patients),and intravenous urography was done for patients with urinary tract abnormalities on ultrasonography (41patients).

**Results;** the results of the present study showed that about 63( 59.4%)of infants and children with (culture positive) urinary tract infections had positive ultrasonic findings ,the most frequent ultrasonic findings was pelvicalyceal and ureteral dilatation which was observed in 32.6%. Thirty four(32.6% )of patients had positive findings on voiding cystography ,( grade 5&4 reflux found in 22.4%). The intravenous urography study was beneficial in diagnosis of pelviureteric junction obstruction in 12.2% and visualized the obstructive effect of renal and ureteric stones in 24.4%.

**Conclusion;** the positive radiological findings supported the idea that the patients with recurrent urinary tract infections need imaging work up.

**Keywords:** radiological findings, imaging studies, paediatric urinary tract infections.

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### Introduction:

Imaging evaluation: deciding which studies are necessary in a child with a presumptive or diagnosed uti should depend on whether potential radiologic findings would change the child's clinical management (1).there is more controversy than consensus regarding the appropriateness of different diagnostic imaging modalities in the evaluation of uti in children the most commonly used imaging techniques are discussed in the following sections. (2). The voiding cystourethrography(vcu) (vcug) is the most important examination in assessing vesicoureteral reflux in children and, as such, is important for assessing utis(urinary tract infections). The vcug may be performed either with fluoroscopy and iodinated contrast material or with nuclear imaging agents (usually 99mTc-pertechnetate) using similar techniques (direct radionuclide cystography), but these studies give different information. The traditional fluoroscopic vcug can show urethral and bladder abnormalities and vesicoureteral reflux. (3, 4).the vcug may be performed as soon as the urine is sterile and voiding is normal .(5).Renal ultrasonography is the standard for evaluating the pediatric urinary tract after uti and has replaced intravenous pyelography. Because this modality is not dependent upon renal function, ultrasonography detects both gross and subtle abnormalities of the urinary tract including those that involve poorly functioning or nonfunctioning renal units. Routine

renal ultrasonography is not as sensitive as dmsa at detecting the subtle changes associated with acute uti. (6, 7). Nuclear renography ; because nuclear scintigraphy can detect areas of acute renal inflammation and chronic scarring, this test has improved detection of renal inflammation in pediatric uti over the past 10 years. Because approximately 60% of injected 99mTc-dmsa is bound to the proximal renal tubular cells and is excreted slowly in the urine, it is a good cortical imaging agent.mg3 or 99mTc-glucoheptonate may be almost as effective as dmsa in detecting changes of acute pyelonephritis.(8,9).Intravenous urography : intravenous urography still defines collecting system abnormalities in more detail than either dmsa or ultrasonography. It is probably most useful in defining the collecting system in patients with confusing situations or in whom calyceal detail may be important. (10).Computed tomography and magnetic resonance imaging : although seldom used to evaluate acute renal inflammatory processes unless unusual or complicating anatomic configurations are seen on ultrasonography, ct and mri reveal detailed and sensitive signs of acute renal inflammation .(3)(10).

### Patients and methods:

This prospective study was conducted through 2008-2009 included 104 pediatric patients their age ranged (4days-5years),61 males and 43 females , the patients were referred to children welfare teaching hospital,( paediatric nephrological out patient clinic)

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with signs and symptoms suggestive of urinary tract infections, *the following work was done;*

Detailed history was taken for each patient included in the study and this including (name ,age, sex ,gender, body weight , signs and symptoms).

Patients included in this study are those who fulfill these criteria; -signs and symptoms of uti( fever,dysuria ,reluctant to feed..).

-gue show pus cells/hpf. (significant more than 5 pus cells /hpf). -heavy growth of one type of bacteria in urine culture.

Urine sample is collected by two ways; Those who are toilet trained ,( mid stream urine ) was taken. And those who are not toilet trained,adhesive bag were used for urine collection, and urine examination is done within 30 minutes.(invasive methods such as cathetrization and suprapubic aspiration was not used routinely).

All patients (104) with cultured positive uti, under went ultrasonographic examination.

Vcu (voiding cystourethrography) was done for (58%) patients, when it was clinically indicated for the following patients;

A-patients with recurrent uti.

B-patients with febrile uti.

C-patients with ultrasonic findings highly suggestive of vur.(all patients with pelvicalyceal and ureteric dilatation ).(3). Vcu;the procedure is performed by introducing a small catheter in the urethra ,and the radiopaque material injected into the bladder ,and x-ray is taken during the act of voiding.(4,5). Ivu(intravenous urography) was done for 41 patients , (for those patients with ultrasonic abnormalities). Nuclear renography: this test is very useful and can detect areas of acute renal inflammation and chronic scarring and differential renal function but this test was not available in this hospital .

### Results:

We can classify our results according to the followings;Patients data:\_data from 104 pediatric patients were analyzed:

The total no. Of patients included were 104.the no. Of female patients was 43(41.3%).the no. Of male patients was 61(58.7%).male to female ratio was 1.4:1.age range was between 4 days and 5 years. All patients had culture positive uti with e-coli constitute about 42% of the infecting microorganisms. This followed by proteus species (21%) and entrobacter species. (20%). Fever was the most common presenting symptoms (57%), followed by difficulty in micturation and turbid urine. (26% for each).each patient my have more than one symptom. Table (1). *Ultrasonography* was done for all patients (104 pediatric patients with culture positive uti). The ultrasonographic examination was negative in 41 patients (40.6%), while the most common findings observed in our study were: bilateral hydronephrosis and hydroureter which was observed in 19 patients (18.2%),this was followed by unilateral hydronephrosis and hydroureter in 15 patients (14.4%).features of renal scaring and chronic renal parenchymal disease

(previous recurrent attacks of acute pyelonephritis )in 14 patients (13.4%).table (2) .Voiding cystourethrography was done for 58 pediatric patients(from 104) with culture positive urinary tract infections when it clinically indicated :

The study was negative in 24 patients (41.4%), unilateral grade 4 reflux was found in 7 patients (12.1%).unilateral grade 5 reflux was found in 6 patients(10.3%).bilateral low grade reflux was found in 6 patients(10.3%).table (3). Intravenous pyelography was done for 41(39.4%) pediatric patients (from 104) with culture positive urinary tract infections when it was clinically indicated for those children suspected to have upper tract abnormalities by history physical examination and ultrasonic findings.(e.g;pelviureteric junction obstruction,stones..).

The followings results were obtained:

This test was normal in 5 patients (12.2%).

The most common findings was unilateral hydronephrosis and hydroureter which was found in 11 patients (28.6%).renal stones was found in 9 patients(22%).bilateral hydronephrosis and hydroureter was found in 6 patients(14.6%).pelviureteric junction obstruction was found in 5 patients (12.2%).vesical stones was found in 2 patients( 4.9%).non functioning kidney was found in 2 patients(4.9%).ureteral stone was found in one patient (2.4%). Table (4):

**Table 1;frequency of clinical presentation of 104 patients**

Clinical features (n=104)	N	%	95% confidence interval for proportion (%)
Fever	61	58.7	(48.2 to 67.2)
Difficulty in micturition	28	27	(17.6 to 34.4)
Turbid urine	28	27	(17.6 to 34.4)
Heamaturia	20	19.3	(10.9 to 25.7)
Poor feeding	17	16.4	(8.5 to 22.3)
Frequent bowel motions	14	13.5	(6.1 to 18.9)
Symptoms of renal failure	7	6.7	(1.9 to 11.5)
Failure to thrive	5	4.8	(0.7 to 8.9)
	104		

**Table (2); the ultrasonographic findings of 104 patients;**

Ultrasound findings (n=104)	N	%	95% confidence interval for proportion (%)
Negative (no abnormality)	41	40.6	(26.4 to 44.8)
Bilateral hydronephrosis and hydroureter	19	18.2	(11.6 to 26.8)
Unilateral hydronephrosis and hydroureter	15	14.4	(8.5 to 22.3)
Renal scaring and chronic paranchymal disease	14	13.4	(7.7 to 21.1)
Renal stone	13	12.5	(6.1 to 18.9)
isolated hydronephrosis	12	11.5	(5.4 to 17.6)
Features of cystitis	5	4.8	(0.7 to 8.9)
Vesical stone	4	3.8	(0.1 to 7.5)
Dysplastic small sized kidney	4	3.8	(0.1 to 7.5)
Hydroureter	2	1.9	(0 to 4.5)
Ureteric stone	1	1	(0 to 2.9)
Over distended urinary bladder	1	1	(0 to 2.9)
Absence of kidney	1	1	(0 to 2.9)
	104	100	

**Table(3); the results of voiding cystourethrography for 58 pediatric patients**

Voiding cystourethrography	N	%	95% confidence interval for proportion (%)
Negative	24	23	(28.7 to 54.1)
Grade one unilateral vesicoureteral reflux	1	1.7	(0 to 5)
Grade two unilateral vesicoureteral reflux	5	8.6	(1.4 to 15.8)
Grade three unilateral vesicoureteral reflux	5	8.6	(1.4 to 15.8)
Grade four unilateral vesicoureteral reflux	7	12.1	(3.7 to 20.5)
Grade five unilateral vesicoureteral reflux	6	10.3	(2.5 to 18.1)
Bilateral vesicoureteral reflux (low grade)	6	10.3	(2.5 to 18.1)
Bilateral vesicoureteral reflux (high grade)	4	6.9	(0.4 to 13.4)
Total	58	100	

**Table (4): the findings of intravenous pyelography.**

Intravenous urography	N	%	95% confidence interval for proportion (%)
Normal	5	12.2	(2.2 to 22.2)
Hydronephrosis and hydroureter	11	26.8	(13.2 to 40.4)
Renal stone	9	22	(9.3 to 34.7)
Bilateral hydronephrosis and hydroureter	6	14.6	(3.8 to 25.4)
Puj (pelviureteric junction obstruction)	5	12.2	(2.2 to 22.2)
Vesical stone	2	4.9	(0 to 11.5)
Non functioning kidney	2	4.9	(0 to 11.5)
Ureteral stone	1	2.4	(0 to 7.1)
Total	41	100	

**Discussion:**

In this study , ultrasonography was done for all patients included (104 patients).the high percentage of positive findings(59.4%)observed in this study may be due to the fact that our hospital is a referral centre and most of cases were referred to the hospital were complicated. Features suggestive of vesicoureteral reflux e.g.; bilateral or unilateral renal and ureteric dilatation with or without renal scarring (as complication of long standing vur), still constitute the majority of the ultrasonic findings (46%)of cases. This is similar to study done in italy which has been found in (35-40%) of children with uti (10). Renal scarring found in association with vur(reflux nephropathy)is an important cause of hypertension and end stage renal disease in this study renal scarring observed in (13.4% )of patients. Actually the percentage may be higher because of non availability of more precise imaging studies such as dmsa scanning in our hospital. (9, 11). Nephrolithiasis was found in (12.5%) of patients, it was the second pathology after vur this is similar to the study done by dr.fathi. (12). The most common cause of dilatation of collecting system in this study was vur (57%) and then pelviureteric junction obstruction (19%). In one study done by foresman *et al* which reported dilatation of the kidney in (28%) patients with uti (7). While in the study done by mahant s *et al* found that the sensitivity and

specificity of ultrasound for detection of vur were 40% and 76% respectively (13). In other study done by dipietro, 20% of patients with uti had dilation of collecting system so that ultrasound is not reliable for detection of vur in children aged 5 yr or older, (5). in fact, one study done by hoberman *et al*, revealed that only three out of five children with high-volume vesicoureteral reflux had dilation on their ultrasound.(1).in this study voiding cystourethrography was done for (58) pediatric patients(from 104) with culture positive urinary tract infections when it was clinically indicated . The study was positive in (32.6% )of above selective groups of patients ,the reflux was unilateral in (41.4%)of cases and bilateral in(17.2%), with grade (4 and 5 )reflux constitute( 22.4% )of unilateral cases while low grade reflux constitute( 10.3%)of bilateral cases. In one study done by ahmadzadeh reviewed 158 patients (aged one month to 15 years) who were hospitalized with symptomatic uti during a 2-year period (2001-2003). (39.6%), were found to have vur . Vur was bilateral in 18 (14.3%) and unilateral in 32 (25.3%). With grade iii (19.8%) constitute the majority.(14). Because of the availability of more precise imaging, (dmsa scanning) in many centres the use of intravenous pyelography has limited applications now days. (15). We performed the study in 41 patients (for those patients with abnormal findings on ultrasound examination suspected to have upper tract abnormalities). Although the high percentage of positive findings( 87.8%ings ) of selected cases, the study was beneficial in diagnosis of pelviureteric junction obstruction in (12.2%) and visualized the obstructive effect of renal and ureteric stones in (24.4%).the majority of other findings(41.4%) were already observed in ultrasonography or vcug (renal and ureteric dilatation)as a consequences of vur. (16). h kangaroo *et al*, recommended that when the sonogram is normal, excretory urography is not considered necessary, but voiding cystourethrography is thought to be essential,if sonography is abnormal, excretory urography and/or other follow-up studies may be indicated. (17).

**References:**

- 1-hoberman a, charron m, hickey rw, *et al*. Imaging studies after a first febrile urinary tract infection in young children. *N engl j med*.2003;348:195-202.
- 2-hitzel a, liard-zmuda a, manrique a, dacher jn, vera p. Comparative study of dmsa scintigraphy (dmsa) and doppler sonography (ds) in the diagnosis of acute pyelonephritis and scarring in children. *Program and abstracts of the 47th annual meeting of the society of nuclear medicine; june 3-7, 2000; st. Louis, missouri. Abstract 209*.(internet).
- 3- José b. López sastre, antonio ramos aparicio<sup>1</sup>, gil d. Coto cotallo, belén fernández colomer, manuel crespo hernánde and grupo de hospitales castrillo : urinary tract infection in the newborn: clinical and radio imaging studies, *paediatric nephrology journal*, 2007 jan.16:1735-1741.

- 4- smellie j, edwards d, hunter n, normand ic, prescod n. Vesico-ureteric reflux and renal scarring. *Kidney int suppl* 1995;(vol 4):s65-72.
- 5- dipietro ma, blane ce, zerin mg. Vesicoureteral reflux in older children: concordance of ultrasonic and voiding cysturethrographyic finding. *Radiology* 1997; 205; 821-8228.
- 6-zamir, g, sakran, w, horowitz, y, et al. Urinary tract infection: is there a need for routine renal ultrasonography?. *Arch dis child* 2004; 89:466.
- 7- foresman wh, hulbert wc, jr rabinowitz r. Does urinary tract ultrasonography at hospitalization for acute pyelonephritis predict vescoureteral reflux?. *J urol* 2001; 165 : 2232-2234.
- 8- rushton, hg, majd m, jantausch b, wiedermann bl, belman ab. Renal scarring following reflux and nonreflux pyelonephritis in children: evaluation with a 99m technetium-dimercaptosuccinic acid scintigraphy. *J urol* 2008;147:1327-32 .
- 9- r b.r. Nammalwar, m. Vijayakumar,.role of dmsa in pediatric uti, *journal of indian pediatrics* 2006; 43:271-274.
- 10- doganis, d, mavrikou, m, delis, d, et al. Timing of voiding cystourethrography in infants with first time urinary infection. *Pediatr nephrol* 2009; 24:319.
- 11- practice parameter: the diagnosis, treatment, and evaluation of the initial urinary tract infection in febrile infants and young children. American academy of pediatrics. Committee on quality improvement. Subcommittee on urinary tract infection. *Pediatrics* 1999; 103:843.
- 12- fathi g a .vesicouretral reflux in children .thesis submitted to the sientific council of pediatrics,iraq,2002 .
- 13- mahant s, friedman j, macartur c. Renal ultrasound findings and vesicoureteral reflux in children hospitalized with urinary tract infection. *Arch dis child* 2002; 86: 419-421
- 14- ali ahmadzadeh, shahnam askarpour association of urinary tract abnormalities in children with first urinary tract infection , *pak j med sci* 2007january - march : 23 (1): 88-91.
- 15- slovis tl. Is there a single most appropriate imaging workup of a child with an acute febrile urinary tract infection? *Pediatr radiol* 1995;25(suppl 1): s46-9.
- 16- marie e westwood, penny f whiting, julie cooper, ian s watt, and jos kleijnen further investigation of confirmed urinary tract infection (uti) in children under five years: a systematic review,article,2005.
- 17- h kangarloo, rh gold, rn fine, mj diamant and mi boechat , urinary tract infection in infants and children evaluated by ultrasound, article. *Radiology*, 1993,154; 367-373.